

**Amendment and Response**

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Serial No.: 09/651,702

Confirmation No.: 2471

Filed: August 30, 2000

For: SUPERCRITICAL COMPOSITIONS FOR REMOVAL OF ORGANIC MATERIAL AND METHODS OF USING SAME

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**Remarks**

The Office Action mailed March 20, 2003 has been received and reviewed. New claims 49-54 having been added, the pending claims are claims 19-25, 27-29, 31-32, and 43-54.

The specification has been amended by deleting recitations from the Abstract of the Disclosure to comply with the requirements of 37 C.F.R. §1.72(b).

New claims 49 and 52 are supported by claim 19 and the specification at, for example, page 1, lines 15-21. New claims 50 and 53 are supported by claim 25 and the specification at, for example, page 1, lines 15-21. New claims 51 and 54 are supported by claim 27 and the specification at, for example, page 1, lines 15-21.

Reconsideration and withdrawal of the rejections are respectfully requested.

**Objection to the Specification**

The Examiner objected to the specification because the Abstract of the Disclosure was longer than 150 words. The Abstract of the Disclosure has been amended, rendering the objection moot. Applicant respectfully requests that the objection be withdrawn.

**Rejection under 35 U.S.C. §102**

The Examiner rejected claims 19, 22, and 46 under 35 U.S.C. §102(b) as allegedly being anticipated by U.S. Pat. No. 5,389,263 (Gallagher et al.). Applicant respectfully traverses the rejection.

"[F]or anticipation under 35 U.S.C. 102, the reference must teach *every aspect* of the claimed invention either explicitly or impliedly." M.P.E.P. §706.02 (emphasis added). Independent claims 19 (and dependent claims 22 and 46) of the present application recites a "composition comprising sulfur trioxide (SO<sub>3</sub>) in a supercritical state, wherein the composition is an organic material removal composition."

Gallagher et al. disclose "a process for *separating mixtures* of crystalline solids which comprises: . . . [d]issolving the solid mixture *to be separated* in a liquid solvent . . . [and]

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[a]dding to the solution of liquid solvent plus dissolved solid, a volume of gas or supercritical fluid anti-solvent sufficient for *inducing precipitation* of only one component of the mixture" (column 3, lines 39-46, emphasis added). Gallagher et al. disclose anti-solvents including sulfur trioxide (SO<sub>3</sub>) (e.g., column 8, lines 56-57; column 9, lines 37-38; and column 10, lines 25-26).

However, Gallagher et al. fail to explicitly or impliedly teach *every aspect* of the presently claimed invention (e.g., claims 19, 22, and 46). For example, Gallagher et al. fail to explicitly or impliedly teach *an organic material removal composition* (e.g., claim 19). When read in view of the specification, Applicant respectfully submits that it would be clear to one of skill in the art that an *organic material removal composition* is a composition that is useful for "removal of organic material, e.g., etching or cleaning of resists, organic residues, etc., from surfaces" (page 1, lines 10-11 of the present specification). In distinction to *remove* (e.g., "to get rid of"), Applicant notes that *separate* is defined as "to isolate from a mixture." *See, for example*, Webster's New Collegiate Dictionary, 971 and 1048 (1979), submitted in the accompanying Information Disclosure Statement. Thus, Applicant respectfully submits that Gallagher et al. fail to disclose or suggest present claims 19, 22, and 46.

Moreover, present claim 22 recites that "the composition consists essentially of sulfur trioxide in the supercritical state." In contrast, the separation methods disclosed by Gallagher et al. recite "[a]dding to the *solution of liquid solvent plus dissolved solid*, a volume of gas or supercritical fluid anti-solvent" (column 3, lines 39-46, emphasis added), wherein the anti-solvent may be sulfur trioxide (SO<sub>3</sub>) (e.g., column 8, lines 56-57; column 9, lines 37-38; and column 10, lines 25-26). Thus, the separations disclosed by Gallagher et al. recite solutions that include, in addition to sulfur trioxide, *liquid solvent plus dissolved solid*. Applicant respectfully submits that Gallagher et al. fail to disclose or suggest present claim 22.

Furthermore, present claim 46 recites that the composition further comprises "a component selected from the group consisting of hydrogen chloride, hydrogen bromide, hydrogen fluoride, ammonium fluoride, tetramethylammonium fluoride, tetramethylammonium hydroxide, beta-diketones, fluorinated-diketones, organic acids, and combinations thereof."

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Gallagher et al. fail to specifically disclose or suggest an organic material removal composition that includes *a component selected from the group consisting of hydrogen chloride, hydrogen bromide, hydrogen fluoride, ammonium fluoride, tetramethylammonium fluoride, tetramethylammonium hydroxide, beta-diketones, fluorinated-diketones, organic acids, and combinations thereof*. Applicant respectfully submits that Gallagher et al. fail to disclose or suggest present claim 46.

Applicant respectfully requests that the Examiner reconsider and withdraw the rejection under 35 U.S.C. §102.

**Rejection under 35 U.S.C. §103**

The Examiner rejected claims 20-21, 23-25, 27-29, 31-32, 43-45, and 47-48 under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Pat. No. 5,389,263 (Gallagher et al.). Applicant respectfully traverses the rejection.

*First*, claims 20-21, 23-25, 27-29, 31-32, 43-45, and 47-48 all depend from or include the same recitations as claim 19 (e.g., a composition comprising sulfur trioxide (SO<sub>3</sub>) in a supercritical state, wherein the composition is an organic material removal composition). For at least the reasons recited herein above for the patentability of claims 19, Applicant respectfully submits that claims 20-21, 23-25, 27-29, 31-32, 43-45, and 47-48 are also patentable over the art of record.

*Second*, claims 47-48 include the same recitations as claim 46 (e.g., a component selected from the group consisting of hydrogen chloride, hydrogen bromide, hydrogen fluoride, ammonium fluoride, tetramethylammonium fluoride, tetramethylammonium hydroxide, beta-diketones, fluorinated-diketones, organic acids, and combinations thereof). For at least the reasons recited herein above for the patentability of claims 46, Applicant respectfully submits that claims 47-48 are also patentable over the art of record.

*Finally*, claims 29 and 31 depend from independent claim 27 and further recite either "a ratio of the first component to the total of the second component plus sulfur trioxide is

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about 1:100 by volume to about 100:1 by volume" (e.g., claim 29) or "a ratio of carbon dioxide:sulfur trioxide is about 10:1 by volume to about 1:1 by volume" (e.g., claim 31). As admitted by the Examiner, Gallagher et al. are silent regarding the ratios recited in present claim 29 and 31. Even though Gallagher et al. is completely silent regarding the recited ratios, the Examiner asserted that it is unpatentable to discover optimum operating conditions or ranges of general conditions *disclosed in the prior art*, and cited as support *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). Applicant respectfully traverses the Examiner's argument.

Applicant respectfully submits that the *In re Boesch* opinion (Exhibit A) is applicable to a different set of facts than the present application. Specifically, the ranges of constituents in Appellants' claimed alloys overlapped the *ranges disclosed in the prior art* (e.g., *In re Boesch*, 205 USPQ at 218). In contrast, and as admitted by the Examiner, Gallagher et al. *do not disclose any ranges*. Furthermore, "[a] particular parameter must first be recognized as a result-effective variable, i.e., a *variable which achieves a recognized result*, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation." M.P.E.P. §2144.05, citing *In re Boesch* (stating that the "prior art suggested proportional balancing to achieve desired results in the formation of an alloy"). Since Gallagher et al. fail to disclose or suggest an organic material removal composition, Applicant respectfully submits that the ratios recited in claims 29 and 31 *cannot be variables that achieve a recognized result* (e.g., removal of organic material from surfaces).

In view of the remarks presented herein above, Applicant respectfully requests that the Examiner reconsider and withdraw the rejection under 35 U.S.C. §103.

**New Claims**

Applicant respectfully submits that new claims 49-54 are patentable over the art of record for at least the reasons presented herein above for the patentability of claims 19, 25, and 27. Moreover, the art of record fails to teach or suggest a "composition comprising sulfur trioxide (SO<sub>3</sub>) in a supercritical state, wherein the composition is a composition for removing

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exposed organic material from an object" (e.g., new claims 49-51) or a "composition comprising sulfur trioxide ( $\text{SO}_3$ ) in a supercritical state, wherein the composition is a composition for removing exposed organic material from a substrate assembly" (e.g., new claims 52-54).

Applicant respectfully requests that the Examiner consider and pass new claims 49-54 on to allowance.

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**Summary**

It is respectfully submitted that all the pending claims are in condition for allowance and notification to that effect is respectfully requested. The Examiner is invited to contact Applicant's Representatives, at the below-listed telephone number, if it is believed that prosecution of this application may be assisted thereby.

Respectfully submitted for

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PATENT TRADEMARK OFFICE

June 20, 2003

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**CERTIFICATE UNDER 37 CFR §1.8:**

The undersigned hereby certifies that this paper is being transmitted by facsimile in accordance with 37 CFR §1.6(d) to the Patent and Trademark Office, addressed to Assistant Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 20<sup>th</sup> day of June, 2003, at 3:40 pm (Central Time).

By:

Name: Jill R. Aguilar

**APPENDIX A - SPECIFICATION/CLAIM AMENDMENTS  
INCLUDING NOTATIONS TO INDICATE CHANGES MADE**

Serial No.: 09/651,702

Docket No.: 150.00800102

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Amendments to the following are indicated by underlining what has been added and bracketing what has been deleted. Additionally, all amendments have been indicated by the use of bold typeface.

**In the Specification**

The paragraph beginning at page 25, line 5 (i.e., Abstract of the Disclosure), has been amended as follows:

A method for removing organic material in the fabrication of structures includes providing a substrate assembly having an exposed organic material and removing at least a portion of the exposed organic material using a composition including sulfur trioxide (SO<sub>3</sub>) [having at least one component] in a supercritical state. [The composition includes an oxidizer selected from the group of sulfur trioxide (SO<sub>3</sub>), sulfur dioxide (SO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), NO, NO<sub>2</sub>, ozone (O<sub>3</sub>), hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), F<sub>2</sub>, Cl<sub>2</sub>, Br<sub>2</sub>, and oxygen (O<sub>2</sub>).] For example, the exposed organic material may be selected from the group of resist material, photoresist residue, UV-hardened resist, X-ray hardened resist, carbon-fluorine containing polymers, plasma etch residues, and organic impurities from other processes. [The at least one component in a supercritical state may be an oxidizer selected from the group of sulfur trioxide (SO<sub>3</sub>), sulfur dioxide (SO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), NO, NO<sub>2</sub>, ozone (O<sub>3</sub>), hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), F<sub>2</sub>, Cl<sub>2</sub>, Br<sub>2</sub>, and oxygen (O<sub>2</sub>); preferably sulfur trioxide. Further, the composition may include a supercritical component in a supercritical state selected from the group of carbon dioxide (CO<sub>2</sub>), ammonia (NH<sub>3</sub>), H<sub>2</sub>O, nitrous oxide (N<sub>2</sub>O), carbon monoxide (CO), inert gases (e.g., nitrogen (N<sub>2</sub>), helium (He), neon (Ne), argon (Ar), krypton (Kr), and xenon (Xe); preferably carbon dioxide.] Further, organic material removal compositions for performing such methods are provided.

**In the Claims**

For convenience, all pending claims are shown below.

**Amendment and Response - Appendix A**

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19. A composition comprising sulfur trioxide (SO<sub>3</sub>) in a supercritical state, wherein the composition is an organic material removal composition.
20. The composition of claim 19, wherein the composition further comprises at least one oxidizer selected from the group consisting of sulfur dioxide (SO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), NO, NO<sub>2</sub>, ozone (O<sub>3</sub>), hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), F<sub>2</sub>, Cl<sub>2</sub>, Br<sub>2</sub>, and oxygen (O<sub>2</sub>).
21. The composition of claim 20, wherein the at least one oxidizer is in a supercritical state.
22. The composition of claim 19, wherein the composition consists essentially of sulfur trioxide in the supercritical state.
23. The composition of claim 19, wherein the composition further comprises an additional component selected from the group consisting of carbon dioxide (CO<sub>2</sub>), ammonia (NH<sub>3</sub>), H<sub>2</sub>O, nitrous oxide (N<sub>2</sub>O), carbon monoxide (CO), nitrogen (N<sub>2</sub>), helium (He), neon (Ne), argon (Ar), krypton (Kr), and xenon (Xe).
24. The composition of claim 23, wherein the additional component is carbon dioxide.
25. A composition comprising sulfur trioxide (SO<sub>3</sub>) in a supercritical state and an oxidizer, wherein the composition is an organic material removal composition.
27. A composition comprising:  
a first component selected from the group consisting of carbon dioxide (CO<sub>2</sub>), ammonia (NH<sub>3</sub>), H<sub>2</sub>O, nitrous oxide (N<sub>2</sub>O), carbon monoxide (CO), nitrogen (N<sub>2</sub>), helium (He), neon (Ne), argon (Ar), krypton (Kr), and xenon (Xe);



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a second component selected from the group consisting of sulfur dioxide (SO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), NO, NO<sub>2</sub>, ozone (O<sub>3</sub>), hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), F<sub>2</sub>, Cl<sub>2</sub>, Br<sub>2</sub>, and oxygen (O<sub>2</sub>); and sulfur trioxide (SO<sub>3</sub>) in a supercritical state, wherein the composition is an organic material removal composition.

28. The composition of claim 27, wherein the first component is carbon dioxide.
29. The composition of claim 27, wherein a ratio of the first component to the total of the second component plus sulfur trioxide is about 1:100 by volume to about 100:1 by volume.
31. The composition of claim 28, wherein a ratio of carbon dioxide:sulfur trioxide is about 10:1 by volume to about 1:1 by volume.
32. The composition of claim 27, wherein the first component is in a supercritical state.
43. The composition of claim 27, wherein the second component is in a supercritical state.
44. The composition of claim 27, wherein the first component and the second component are both in supercritical states.
45. The composition of claim 23, wherein the additional component is in a supercritical state.
46. The composition of claim 19 further comprising a component selected from the group consisting of hydrogen chloride, hydrogen bromide, hydrogen fluoride, ammonium fluoride, tetramethylammonium fluoride, tetramethylammonium hydroxide, beta-diketones, fluorinated-diketones, organic acids, and combinations thereof.

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47. The composition of claim 25 further comprising a component selected from the group consisting of hydrogen chloride, hydrogen bromide, hydrogen fluoride, ammonium fluoride, tetramethylammonium fluoride, tetramethylammonium hydroxide, beta-diketones, fluorinated-diketones, organic acids, and combinations thereof.

48. The composition of claim 27 further comprising a component selected from the group consisting of hydrogen chloride, hydrogen bromide, hydrogen fluoride, ammonium fluoride, tetramethylammonium fluoride, tetramethylammonium hydroxide, beta-diketones, fluorinated-diketones, organic acids, and combinations thereof.

49. (New) A composition comprising sulfur trioxide ( $\text{SO}_3$ ) in a supercritical state, wherein the composition is a composition for removing exposed organic material from an object.

50. (New) A composition comprising sulfur trioxide ( $\text{SO}_3$ ) in a supercritical state and an oxidizer, wherein the composition is a composition for removing exposed organic material from an object.

51. (New) A composition comprising:

a first component selected from the group consisting of carbon dioxide ( $\text{CO}_2$ ), ammonia ( $\text{NH}_3$ ),  $\text{H}_2\text{O}$ , nitrous oxide ( $\text{N}_2\text{O}$ ), carbon monoxide ( $\text{CO}$ ), nitrogen ( $\text{N}_2$ ), helium ( $\text{He}$ ), neon ( $\text{Ne}$ ), argon ( $\text{Ar}$ ), krypton ( $\text{Kr}$ ), and xenon ( $\text{Xe}$ );

a second component selected from the group consisting of sulfur dioxide ( $\text{SO}_2$ ), nitrous oxide ( $\text{N}_2\text{O}$ ),  $\text{NO}$ ,  $\text{NO}_2$ , ozone ( $\text{O}_3$ ), hydrogen peroxide ( $\text{H}_2\text{O}_2$ ),  $\text{F}_2$ ,  $\text{Cl}_2$ ,  $\text{Br}_2$ , and oxygen ( $\text{O}_2$ ); and sulfur trioxide ( $\text{SO}_3$ ) in a supercritical state, wherein the composition is a composition for removing exposed organic material from an object.

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52. (New) A composition comprising sulfur trioxide (SO<sub>3</sub>) in a supercritical state, wherein the composition is a composition for removing exposed organic material from a substrate assembly.

53. (New) A composition comprising sulfur trioxide (SO<sub>3</sub>) in a supercritical state and an oxidizer, wherein the composition is a composition for removing exposed organic material from a substrate assembly.

54. (New) A composition comprising:

a first component selected from the group consisting of carbon dioxide (CO<sub>2</sub>), ammonia (NH<sub>3</sub>), H<sub>2</sub>O, nitrous oxide (N<sub>2</sub>O), carbon monoxide (CO), nitrogen (N<sub>2</sub>), helium (He), neon (Ne), argon (Ar), krypton (Kr), and xenon (Xe);

a second component selected from the group consisting of sulfur dioxide (SO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), NO, NO<sub>2</sub>, ozone (O<sub>3</sub>), hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), F<sub>2</sub>, Cl<sub>2</sub>, Br<sub>2</sub>, and oxygen (O<sub>2</sub>); and

sulfur trioxide (SO<sub>3</sub>) in a supercritical state, wherein the composition is a composition for removing exposed organic material from a substrate assembly.